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(54) INCUBATOR



(71) We, HOWORTH AIR ENGINEERING LIMITED, a British Company, of Victoria Works, Lorne Street, Farnworth, Bolton, BL4 7LZ, Lancashire, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to an incubator, particularly, but not necessarily, for use in the treatment of neonates.

Many incubators are known in which heated air is supplied to a closed container to provide a heated environment for a neonate. There are two basic disadvantages with such containers. Firstly, access to the neonate is required for several leads, such as oxygen pipes, temperature sensors and feeding lines, and the connection and monitoring of these leads is best carried out when the neonate is not totally enclosed. Secondly, heat loss from a neonate is by conduction, convection and radiation. The object is to maintain correct temperature equilibrium similar to the mother's womb, so that the neonate neither gains nor loses heat, therefore, his metabolism is basal.

Heat loss by convection can be nil because ambient wet and dry bulb temperatures can be accurately controlled to equilibrium by air flow.

Heat loss by conduction can be significant because the heat gained by solids in contact with the neonate and which are surrounded by convection air at equilibrium temperature will be progressively cooled by radiation so that the convection temperature would have to be artificially high and equilibrium would be lost.

This has the disadvantage that the air cannot be automatically controlled to maintain a constant desired temperature but must be adjusted regularly in response to changes in the temperature of the neonate. Because the uptake of heat by the neonate cannot be accurately determined, such adjustments have to be made empirically, with the result that the temperature of the neonate can be caused to fluctuate by variation in the tem-

perature of the conditioned air. A further disadvantage of totally closed incubators is that access to the neonate, for example for surgery, is hampered.

An object of the invention is to provide an incubator in which the above disadvantages are obviated or minimised.

According to the invention there is provided an incubator comprising an open-topped enclosure having means by which conditioned air can be supplied thereto, the enclosure comprising a base and upwardly extending side walling, at least a part of the side walling incorporating heating means to enable radiant heat to be supplied to the interior of the enclosure.

Preferably the heating means is incorporated in two longitudinal side walls of the enclosure. Conveniently these walls are of transparent heatable material. The walls can be hinged at or near their lower edges to allow them to be lowered when access is required. Alternatively the walls can upstand from supporting channels.

A suitable heatable material is a pair of sheets of glass or similar substance having a substantially transparent electrically conductive layer between them.

To conserve power and prevent overheating of the surroundings of the incubator, the heated air from the enclosure is preferably recirculated.

The invention will be described further, by way of example, with reference to the accompanying drawings, which illustrate a preferred embodiment thereof, it being understood that the following description is illustrative and not limitative of the invention.

In the drawings:—

Fig. 1 is a cross-sectional view of a nursing unit incorporating a preferred incubator of the invention; and

Fig. 2 is an enlarged fragmentary view of part of Fig. 1.

A preferred embodiment of incubator 10 of the invention forms part of a nursing unit 11 which comprises a rectangular box-like housing 12 containing a fan 13, motor and cooling and/or heating means and a 16

humidifier all generally indicated by reference numeral 14 for preparing a supply of conditioned air. When ambient temperature is below blood heat (which is normal in a large percentage of applications) the heater will be used. The upper face 15 of the housing has a central recess 16, and upstanding from two rear corners of the housing are hollow columns 17 which support an air recovery canopy 18 above the housing 12.

Mounted in the recess 16 for pivoting movement about a horizontal transverse central axis 19 is a base 20 of an enclosure 21 of the incubator 10. The base 20 is in the form of a sheet metal tray having a lower central inlet duct 22 connected to the air supply system in the housing 12 by a flexible conduit 23. A mattress support 24 (beneath which may be accommodated an X-ray slide receptacle 25) is mounted in the tray with a spacing from side walling thereof to allow conditioned air to pass between the support and the side walls. The tray can be tilted about the axis 19 up to an angle of 30° to the horizontal.

Side walling of the enclosure is constituted by four panels, 26, 27 and 28 or 29 each in the shape of a truncated triangle. A rear transverse panel 29 is fixed to an end wall of the tray to incline inwardly at an angle of about 40° to the vertical. Longitudinal side panels 26, 27 are hingedly connected to side walls of the tray and in their "closed" positions are also inclined inwardly at about 40° to the vertical. The fourth, front end, panel 28, is hinged to a front end wall of the tray and also inclines inwardly at an angle of about 40° to the vertical when in its "closed" position. In their "open" positions the three panels 26, 27 and 28 can lie flat on the housing surrounding the recess after having been lifted from supporting channels 30 which are secured to side walls of the tray.

The longitudinal side panels 26, 27 are each of two sheets of glass 31, 32, (see Fig. 2) having an electrically-conducting layer (not visible) between them. This layer can be a metallic sprayed cohesive layer, which does not substantially affect the transparency of the panels, 26, 27. The panels 26, 27 are connected to a low-voltage power source in the housing to enable them to be heated to at or about blood heat. Flexible leads to the panels 26, 27 enable them to be removed from channels 30.

In use, all the inwardly inclined panels 26, 27, 28, 29 serve a first major function. They ensure that the conditioned air streams issuing from around the mattress support 24 are deflected inwardly to meet and effectively form a "roof" for the enclosure 21. As a second major function the heated

panels 26, 27 are positioned to supply maximum radiant heat to a neonate (not shown) on a mattress (not shown) supported by support 24. The end panels 28, 29 can be heated, but this has proved to give only marginal advantages.

Instead of being electrically heatable, the panels 26, 27 could be hollow and filled with a heated liquid, e.g. water, however such heating would be complicated and expensive compared to electrical heating. Instead of the substantially transparent metallic coating described, a plurality of conductors could extend across each of the panels 26, 27 still leaving it substantially transparent.

When the incubator has four panels, one or both of the side panels can be heated. The end panels can be heated, but do not have to be. In some cases one of the side panels can be transparent and heated, the other being opaque. If desired, a heated opaque panel can be provided, the opposite panel being transparent and unheated.

WHAT WE CLAIM IS:—

1. An incubator comprising an open-topped enclosure having means by which conditioned air can be supplied thereto, the enclosure comprising a base and upwardly extending side walling, at least a part of the side walling incorporating heating means to enable radiant heat to be supplied to the interior of the enclosure.

2. An incubator as claimed in Claim 1, wherein the said part of the side walling includes at least one electrically heatable panel.

3. An incubator as claimed in Claim 2, wherein the panel is transparent.

4. An incubator as claimed in Claim 3, wherein the panel consists of a pair of sheets of transparent material between which is sandwiched a heating element.

5. An incubator as claimed in any of Claims 1 to 4, wherein the side walling is inwardly inclined as well as upwardly extending.

6. An incubator as claimed in any of Claim 2 to 5, wherein one or more of the panels is hinged to or detachable from the base of the enclosure.

7. An incubator as claimed in any preceding claim and mounted to be tiltable about a transverse axis.

8. An incubator substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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